

March 7, 2006

TO: D. Morris
FROM: A. Andujo
SUBJECT: Phoenix Modified Mars Approach Requirements Study

The Resource Allocation Planning Service has completed a special study to analyze the impact to other DSN users if the Phoenix (PHX) mission increases 70-meter requirements during the Mars Approach, Trajectory Correction Maneuver (TCM) and Entry, Descent and Landing (EDL) phases. Depending on which day it launches, Phoenix is planning on two options for EDL: May 26, 2008 or June 5, 2008. This study looks at both options.

Summary of Results

A review of supports planned for the 70-meter subnet prior to EDL indicates an already elevated level of contention across the 70-meter subnet due to requirements in support of the Phoenix TCM, Approach and EDL phases. The Phoenix mission is proposing to increase the 70-meter continuous coverage to 7 days prior to EDL.

Support for other users of the 70-meter subnet within the Mars view or an overlapping view is heavily impacted. Other Mars missions with previously reduced baseline 70-meter requirements would need to move to 34-meter support for Phoenix. The proposed changes in Phoenix 70-meter requirements negatively affect Cassini (CAS), Spitzer (STF) and 70-meter DSS Maintenance support as well as other Mars missions.

Analysis of Phoenix requirements for the second EDL option, June 6, 2008, leads to the same results with minor differences in support impacts.

Background

The Phoenix mission has requested that the RAPS team perform a study analyzing the impact to supportability of other users of the DSN based on a change of requirements for the Phoenix mission before the EDL phase. The mission is considering changing baseline support requirements by substituting 70-meter standalone for 34-meter standalone in the seven days prior to EDL. In effect, this results in 70-meter continuous coverage plus 13 backup or array 34-meter passes, plus 14 Delta-DOR dual 34-meter passes.

This study focuses on the seven days prior to the planned May 26, 2008 EDL (May 19 – 25, 2008, Week 21) but also includes analysis of the second option for EDL on June 5, 2008.

Analysis

Analysis was accomplished using the JPL Tracking Integrated Ground Resource Allocation System (TIGRAS) scheduling tool, the updated mission set database from the February 2006 Interplanetary Network Customer Forum, Resource Allocation Review (INCF, RAR).

The DSN can support the Phoenix increased requirements prior to EDL. However, there is very little capacity left for other missions in the Mars viewperiod such as Mars Odyssey 2001 (M01O), Mars Reconnaissance Orbiter (MRO), Mars Express (MEX), Mars Global surveyor (MGS) and the Mars Exploration Rovers (MER) or for missions that heavily overlap the Mars viewperiod such as CAS, STF or DSS Maintenance. As a result, forecasted supportability for these missions is severely impacted.

With baseline requirements, it will take creative use of MSPA capability across available subnets to accommodate Mars user's requirements. With the additional 70-meter load from Phoenix, it is unlikely that all other users' requirements will be fully met.

The Phoenix modifications not only decrease 70-meter supportability overall, but also raises the question of moving other Mars missions requirements to 34-meter support only. Baseline 70-meter supportability stands at approximately 77% for all requests during the analysis period. With Phoenix's additional 70-meter requirements and offloading other Mars mission requirements from the 70-meter subnet, forecasted supportability drops to 70%. This decrease in supportability is caused when Phoenix uses the remaining eight 70-meter Mars viewperiods leaving none for other Mars missions to share at the 70-meter. Since Phoenix cannot MSPA, other Mars missions are limited to 34-meter resources only. The amount of other Mars missions' requirements offloaded to the 34-meter is approximately 65 MSPA hours. The offloading of all 70-meter support for M01O and MRO may not be acceptable to those missions.

The following is a list of individual missions requesting 70-meter support in this period and the impact of the Phoenix modifications to each:

Cassini:	Cassini is only allowed a maximum of 5.5 hours at DSS-63 and 2 hours at DSS-14, not including pre and post-cal time, thus not providing Cassini with supportability at the 70-meter subnet due to viewperiod overlap with Mars.
Cluster II:	Cluster II should be able to find available views at all the subnets but will have great difficulty scheduling the array support at the other subnets together.
DSS Maintenance:	There are only blocks of 3 – 7 hours in this period to support the five planned maintenance periods, due to viewperiod overlap with Mars.
EGS:	EGS will need to delete or re-plan support in other weeks.
GSSR:	The GSSR Mercury Observation cannot be supported in the analysis period and will require re-planning to a less contentious week.
M01O:	M01O will not have 70-meter support in the analysis period and will have increased difficulty negotiating support at 34-meter antennas. This may limit high-rate communications increasing the amount of downlink time necessary. M01O will also support MER-A and MER-B with 7 standalone and 7 MSPA Relay passes that will be impacted as well. Use of 34-meter support only may not be acceptable to M01O.

MGS: MGS does not require 70-meter support but was MSPA with M010, and will also have difficulty negotiating for support at 34-meter antennas.

MRO: MRO will not have 70-meter support in this week, and will have difficulty negotiating for support at 34-meter antennas. Use of 34-meter support only may not be acceptable to MRO

SOHO: SOHO should be able to attain full supportability although the viewperiod overlap reduces the six passes for SOHO to fewer than 4 hours.

Spitzer: Spitzer will not be able to attain full supportability due to a 100% viewperiod overlap with Phoenix.

Voyager 1: Voyager 1 should be able to attain full supportability.

Voyager 2: Voyager 2 should be able to attain full supportability.

WMAP: WMAP should be able to attain full supportability.

The following is a list of baseline and proposed supports planned for the 70-meter subnet in week 21 of 2008:

Baseline Requirements							Modified Requirements						
User	Resource	Durations		Calibration		Week	User	Resource	Durations		Calibration		Week
		Ave	Min	Pre	Post				Ave	Min	Pre	Post	
CAS Tour	DSS-14	9.0	4.0	1.00	0.25	1	CAS Tour	DSS-14	9.0	4.0	1.00	0.25	1
CAS Tour	DSS-63	9.0	4.0	1.00	0.25	2	CAS Tour	DSS-63	9.0	4.0	1.00	0.25	2
CLU2 1/2/3/4 SSO	DSS-27/24/15/14	2.0	2.0	0.50	0.25	2	CLU2 1/2/3/4 SSO	DSS-27/24/15/14	2.0	2.0	0.50	0.25	2
CLU2 1/2/3/4 SSO	DSS-46/34/45/43	2.0	2.0	0.50	0.25	1	CLU2 1/2/3/4 SSO	DSS-46/34/45/43	2.0	2.0	0.50	0.25	1
CLU2 1/2/3/4 SSO	DSS-66/54/65/63	2.0	2.0	0.50	0.25	1	CLU2 1/2/3/4 SSO	DSS-66/54/65/63	2.0	2.0	0.50	0.25	1
DSS Bearing Mntc	DSS-43	8.0	8.0			1	DSS Bearing Mntc	DSS-43	8.0	8.0			1
DSS Maintenance	DSS-14	8.0	8.0			2	DSS Maintenance	DSS-14	8.0	8.0			2
DSS Maintenance	DSS-63	6.0	4.0			1	DSS Maintenance	DSS-63	6.0	4.0			1
DSS Maintenance	DSS-63	8.0	8.0			1	DSS Maintenance	DSS-63	8.0	8.0			1
EGS Global VLBI	DSS-14/63	24.0	24.0	1.50	0.50	1	EGS Global VLBI	DSS-14/63	24.0	24.0	1.50	0.50	1
GSSR Mercury	DSS-14	5.2	5.2	1.50	0.50	1	GSSR Mercury	DSS-14	5.2	5.2	1.50	0.50	1
M010 Relay/MGS Mapping	DSS-15,43,65	8.0	4.0	1.00	0.25	7	M010 Relay/MGS Mapping	DSS-15,25,34,65	8.0	4.0	1.00	0.25	7
MRO Prime Science/M010 Mapping	70M,34B2	10.0	4.0	1.00	0.25	7	MRO Prime Science/M010 Mapping	34B2,DSS-34,65	10.0	4.0	1.00	0.25	7
PHX Approach	DSS-25,34,65	8.0	4.0	1.00	0.25	8	PHX Approach	70M	8.0	4.0	1.00	0.25	8
PHX Approach	70M/34H,70M/34B1	8.0	4.0	1.00	0.25	10	PHX Approach	70M/34H,70M/34B1	8.0	4.0	1.00	0.25	10
PHX TCM	70M/34H	8.0	4.0	1.00	0.25	3	PHX TCM	70M/34H	8.0	4.0	1.00	0.25	3
SOHO Keyhole	DSS-14/27,43/46,63/66	4.0	4.0	0.70	0.20	10	SOHO Keyhole	DSS-14/27,43/46,63/66	4.0	4.0	0.70	0.20	10
SOHO Keyhole	DSS-14/46,14/66,43/27	4.0	4.0	0.70	0.20	2	SOHO Keyhole	DSS-14/46,14/66,43/27	4.0	4.0	0.70	0.20	2
STF	70M	1.0	1.0	0.75	0.25	14	STF	70M	1.0	1.0	0.75	0.25	14
VGR1 Routine U/L	DSS-14	2.5	2.5	1.00	0.25	1	VGR1 Routine U/L	DSS-14	2.5	2.5	1.00	0.25	1
VGR2	DSS-43,45,34	6.0	4.0	0.50	0.25	7	VGR2	DSS-43,45,34	6.0	4.0	0.50	0.25	7
VGR2 Routine U/L	DSS-43,34	2.5	2.5	1.00	0.25	1	VGR2 Routine U/L	DSS-43,34	2.5	2.5	1.00	0.25	1
WMAP	DSS-14,43	0.7	0.6	1.25	0.25	7	WMAP	DSS-14,43	0.7	0.6	1.25	0.25	7

Only 5.8 passes existed for other 70-meter Mars users in MSPA vs. 8 passes moved to the 70-meter from the 34-meter for Phoenix

The following is a list of the baseline and proposed Phoenix requirements in the week prior EDL:

Baseline Phoenix Requirements for Week 21							Modified Phoenix Requirements for Week 21						
User	Resource	Durations		Calibration		Week	User	Resource	Durations		Calibration		Week
		Ave	Min	Pre	Post	21			Ave	Min	Pre	Post	21
PHX TCM	70M/34H	8.0	4.0	1.00	0.25	3	PHX TCM	70M/34H	8.0	4.0	1.00	0.25	3
PHX Approach	70M/34H,70M/34B1	8.0	4.0	1.00	0.25	10	PHX Approach	70M/34H,70M/34B1	8.0	4.0	1.00	0.25	10
PHX Approach	DSS-25,34,65	8.0	4.0	1.00	0.25	8	PHX Approach	70M	8.0	4.0	1.00	0.25	8
PHX DDOR	DSS-24/45,24/65	1.0	1.0	1.00	0.25	14	PHX DDOR	DSS-24/45,24/65	1.0	1.0	1.00	0.25	14

Conclusion

Forecast results for the 70-meter subnet indicate that the DSN can support the increased 70-meter Phoenix requirements, but not without severely reducing supportability for other DSN Users. The increase in 70-meter requirements will also adversely impact the 34-meter subnets due to offloading of the 70-meter subnet.

The 34-meter subnet time released by Phoenix may help Mars Missions supportability at the 34-meter subnet, but will not accommodate all users displaced from the 70-meter subnet.

Creative use of the Mars viewperiod overlap between Madrid to Goldstone and Goldstone to Canberra, may allow Spitzer almost all the time they need on the 70-meter, but that still leaves Cassini and DSS Maintenance with reduced support.

If the Phoenix mission chooses to increase, its 70-meter requirements, it is suggested that standalone 70-meter support also include Delta-DOR to minimize resource usage of 34-meter subnet. This will allow other Mars mission's spacecraft contact time and reduce overall 34-meter contention.

If Phoenix can accommodate and ensure that Cassini and Maintenance 70-meter requirements are met, then these modifications may produce 70-meter supportability levels that can be workable in the Mid-Range Scheduling Process. An underlying assumption to this study is that M01O and MRO are required to forego any 70-meter antenna support. It is important to consider the requirements of these missions in any decision.